

# Perception of the Public Concerning Radiation Risk



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# Examining existing perception

- “Rate the risk to you and your family from different sources of hazard ranging from no risk (=1) to high risk (=4)”.

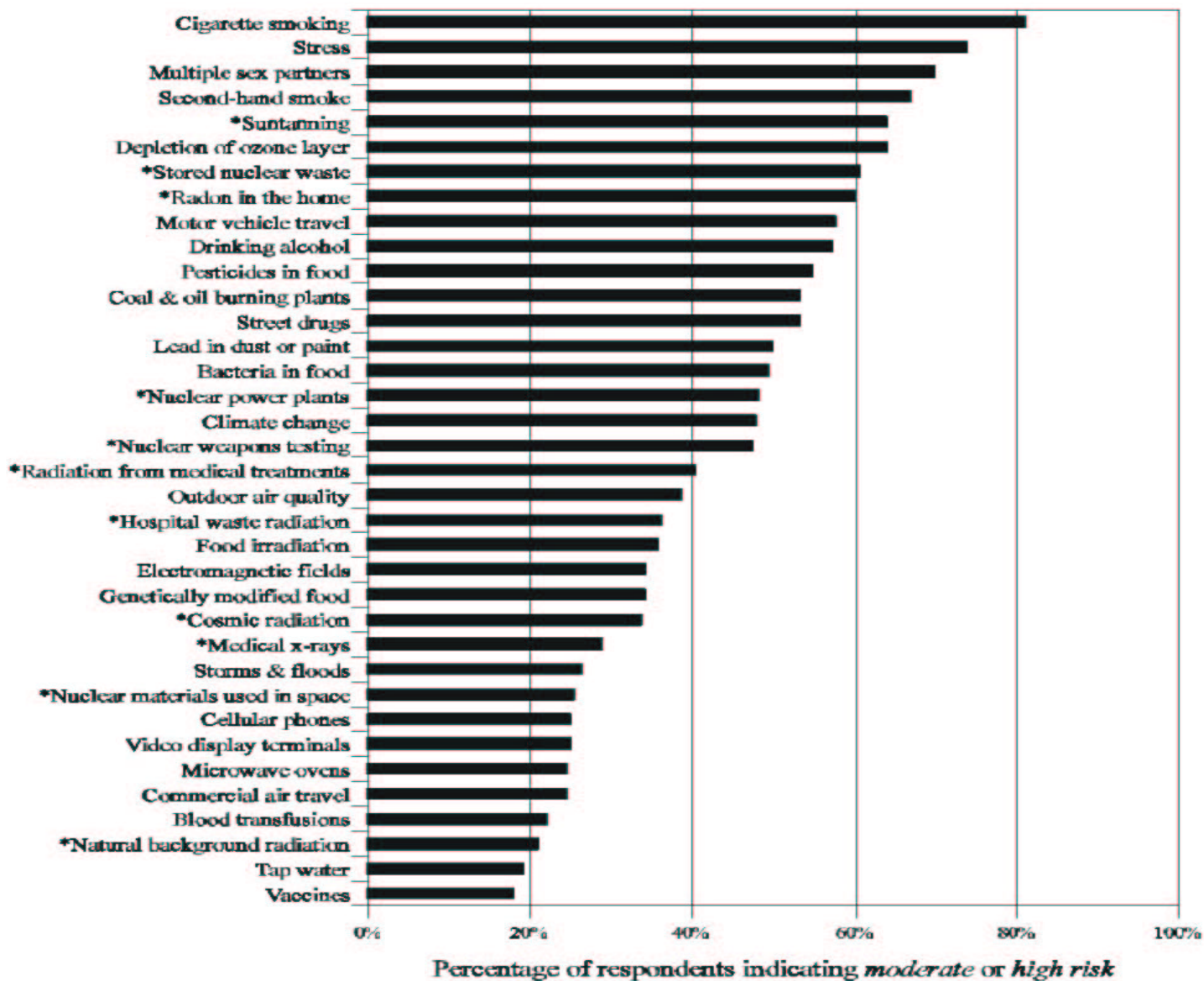
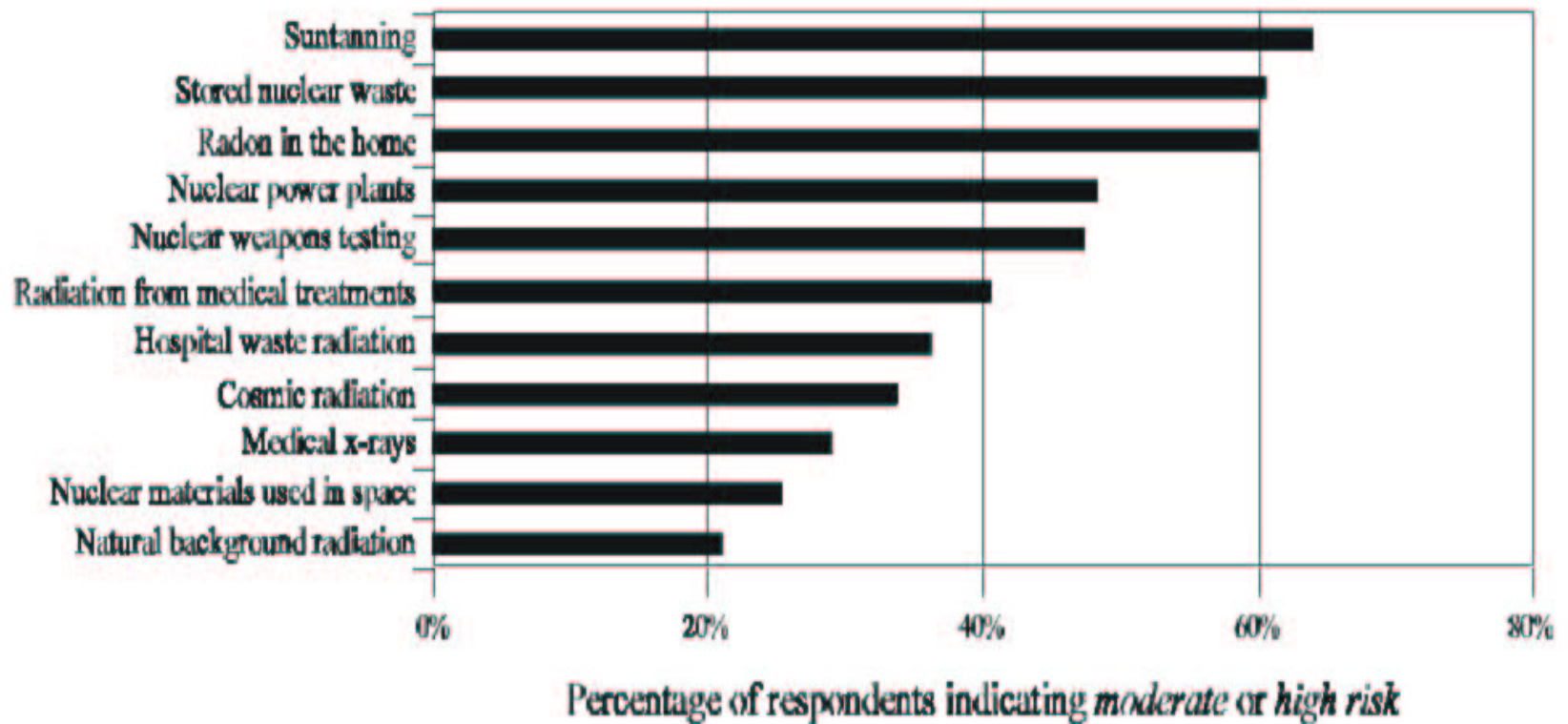


Figure 1. Perceived risk ratings for 36 risk items. \* denotes radiation exposure items.



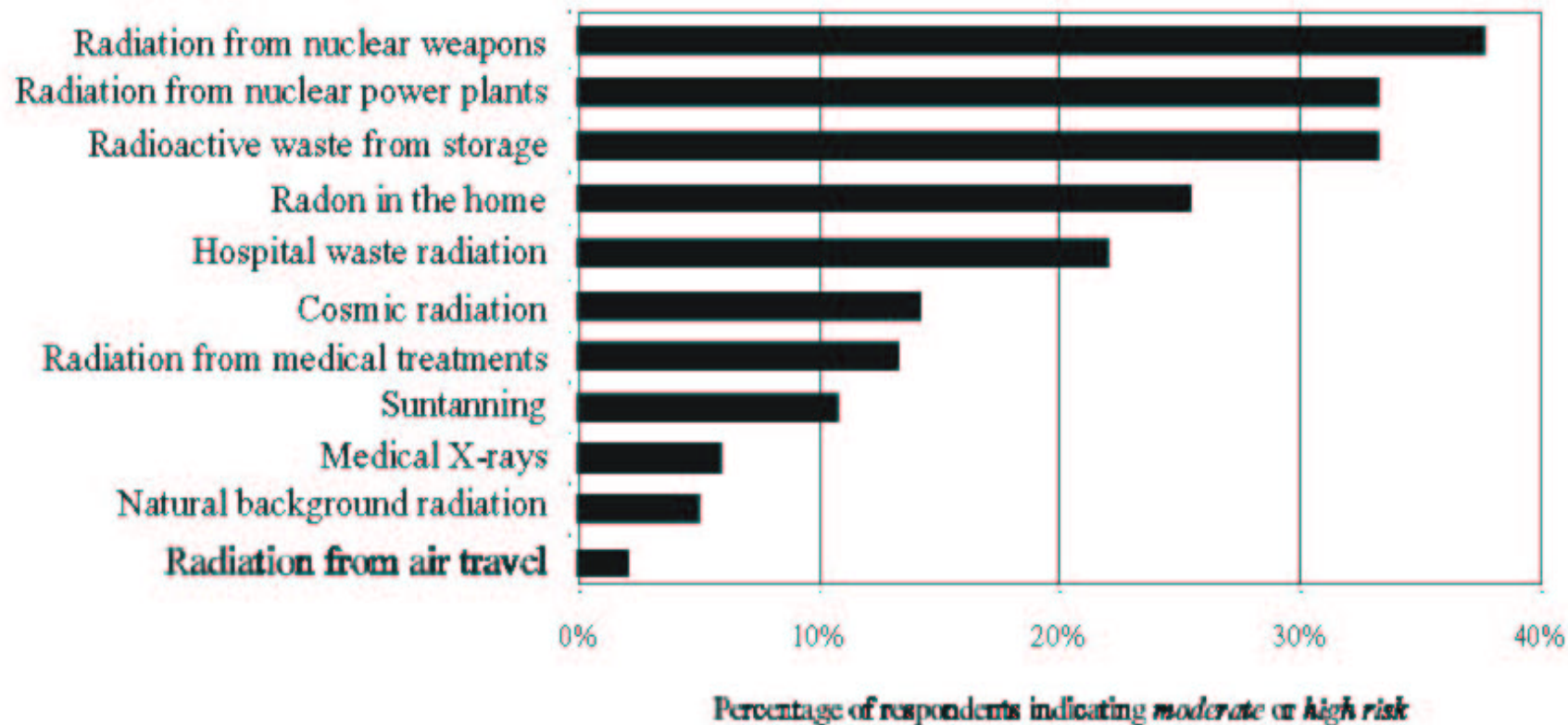
*Figure 2. Perceived risk ratings for 11 sources of radiation exposure.*



# Examining existing perception

- “Judge the degree to which a very low exposure would be harmful to an average individual ranging from no risk (=1) to very high risk (=5).”

*Very low exposure is defined as “an exposure that is substantially less (say 1/100) than the exposure level approved by a regulatory agency or that would begin to cause concern to such an agency”.*

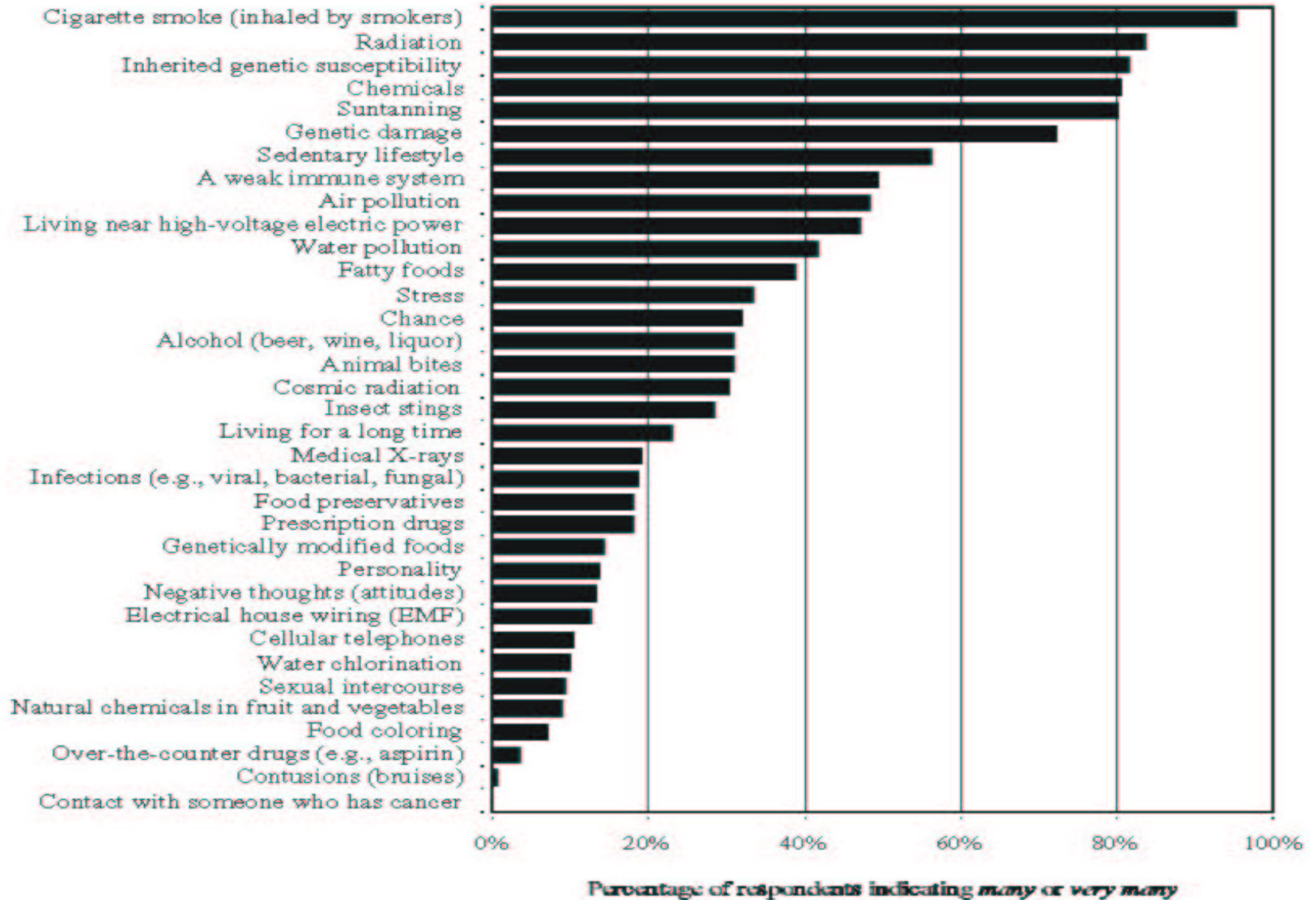


*Figure 4. Risk of very low exposures: ionizing radiation subset.*



# Examining existing perception

- “Indicate how many cancers you thought were caused each year in the U.S. by each of these factors on a four-category scale: almost none (=1), few, many, very many (=4).”

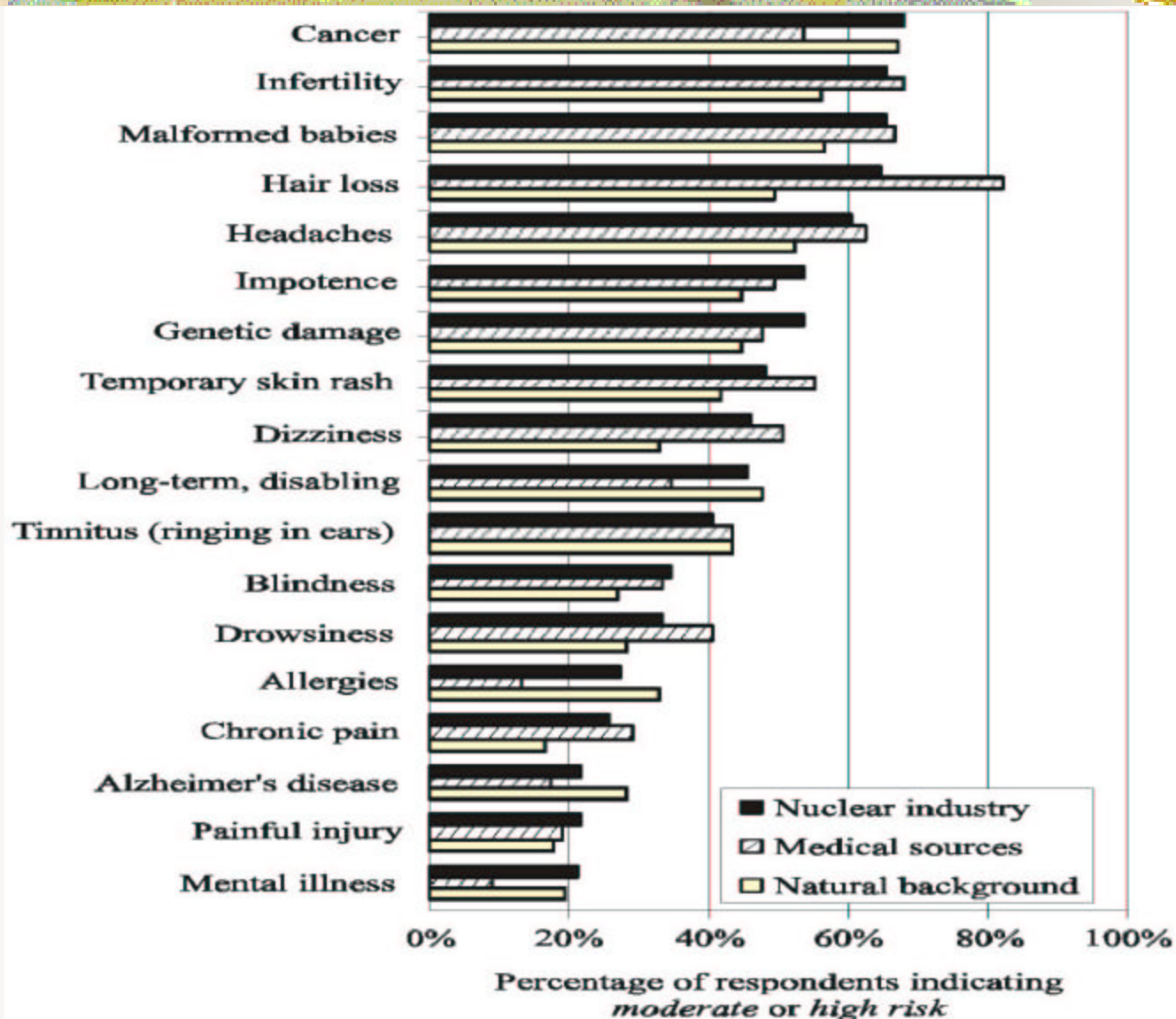


**Figure 5. Factors that cause cancer.**



# Examining existing perception

- Judge the likelihood that each of 18 types of possible harm or illness could be caused by radiation on a four-category scale: not likely (=1), slightly likely, moderately, or very likely (=4)."



**Figure 6.** Sources of radiation as a cause of harm. Items are ranked by responses to “nuclear industry sources of radiation.”



# Observations

- Non-scientists have a limited mental model of the relationship between radiation exposure and health consequences.
- The typical non-scientist does not have a composite view of radiation exposure that is decomposable into a metric by which the risk associated with different radiation exposure sources can be quantitatively gauged.
- Challenge exists to the viability of the notion of “natural background radiation” as a psychological benchmark or natural standard to which other exposures can be compared.
- When non-scientists are confronted with health conditions for which they have no ready explanation, radiation may well become the culprit.



# Information and education:

- Education/risk communication has been considered a key means to change people's perception on nuclear risk.
- Major efforts have been and will continue to be expended to educate the public in this regard.
- Would "Information and Education" change the perception?



# Findings from Empirical Studies

- A study of college student attitudes toward breeder reactors found no relationship between knowledge and attitude [Clelland and Bremseth, 1977]
- For high school teachers who participated in two-week DOE educational workshops, the effect of workshop participation on energy attitudes was quite small [Page and Hood, 1981]
- No consistent empirical basis for the arguments that negative perception stems from ignorance and greater information will change attitudes.

A group of 205 college students was presented with the pie chart.

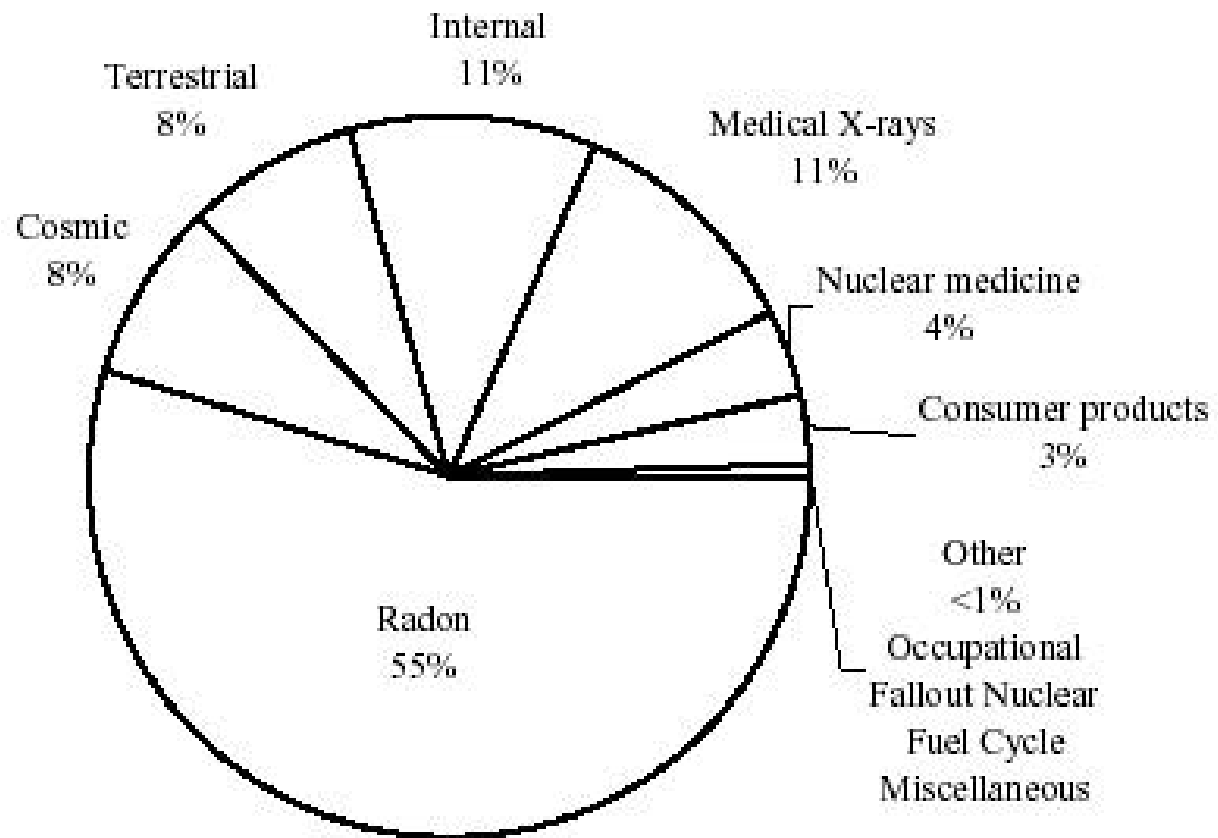


Figure 1. Sources of radiation.

**Table 2. *Expectations About Sources of Radiation***

Source of radiation	Percent <i>larger or much larger</i> than expected	Percent <i>smaller or much smaller</i> than expected
Radon	80.5%	2.9%
Internal	58.5	10.7
Cosmic	39.0	18.1
Medical X-rays	38.1	21.0
Terrestrial	34.2	16.6
Nuclear medicine	13.2	50.2
Consumer products	13.2	43.9
Industrial	3.4	50.2

**Table 5. Attitudes About Radiation Sources Information**

Item	Strongly Disagree	Disagree	Agree	Strongly Agree	Scale Correlations
Radiation exposure from the nuclear fuel cycle is not significant in the overall picture as portrayed by the pie chart.	7.32%	49.27%	36.10%	5.85%	-.21**(LD) -.20**(RP) -.20**(RRP) .20**(RM)
There are important sources of radiation exposure that are not included in the pie chart.	6.83	41.95	44.88	3.41	-.18**(RM)
The sources of radiation exposure shown in the pie chart are so different that they can't be compared.	6.83	62.44	26.34	2.44	--
Background sources of radiation (i.e., cosmic, terrestrial, internal, radon) are natural and shouldn't be compared to human-made sources in the pie chart.	5.85	63.41	28.29	0.98	-.15*(LD) -.15*(RP) -.16*(CC)
The representation of radiation exposure shown in the pie chart is informative and helpful to me in thinking about radiation risks.	1.95	27.80	51.71	17.07	.29*** (CC) .14* (HR) .20** (RM)

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

**Table 9. Attitudes About Sources of Information About Radiation Exposure**

Item	Strongly disagree	Disagree	Agree	Strongly Agree	Scale Correlations
The representation of radiation exposure shown in the pie chart is biased and reflects what the nuclear industry would like people to believe.	5.37%	47.32%	40.98%	3.90%	-.17*(RM)
Given the representation of radiation exposure shown in the pie chart, the source of this data, The National Council on Radiation Protection and Measurements, is probably a pro-nuclear industry group.	4.88	40.49	46.34	6.34	.17*(RRP)

\* $p < .05$ .



# Findings from Empirical Studies

- Attitudes of individuals are derived from basic factors in his personality, and may be relatively little influenced by what he hears and reads [Roder, 1961].
- Knowledge may help in promoting positive attitudes if the situation has not become too polarized already.
- If the situation is already polarized, then the additional information will only reinforce the existing beliefs.



# Risk Perception

- A function of factors that affect the information processing, cognitive heuristics, ability, motivation - familiarity, voluntariness, controllability, worldview, equity issues, fear appeals, known certainty and extent of damage, trust/credibility, framing effects, avoidance of cognitive dissonance, etc.



# Human Information Processing – Central Mode

- Refers to a communication process in which the receiver examines each argument carefully and balances the pros and cons in order to form a well-structured attitude.
- Perceptions that result from central mode will show greater temporal persistence, greater prediction of behavior, and greater resistance to counter-persuasion than the perception resulted mostly from peripheral cues.



# Human Information Processing - Peripheral Mode

- Refers to a faster and less laborious strategy to form attitude by using specific cues or simple heuristics.
- The receiver forms an opinion or even an attitude on the basis of simple cues and heuristics (source-, message-, transmitter-, and context-related cues).

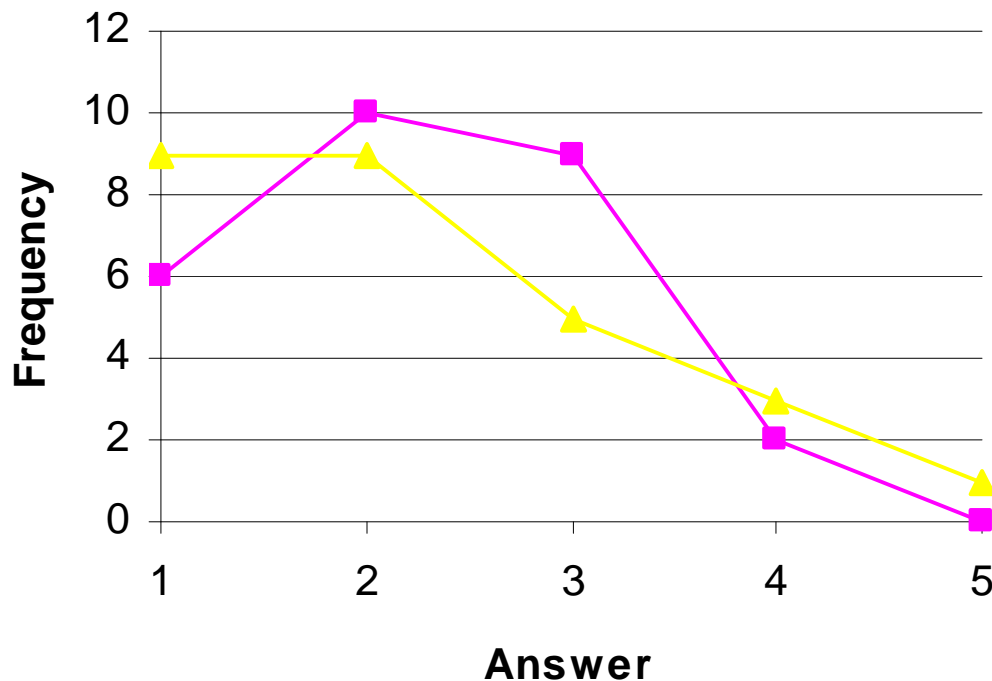
# SCIENCE TEACHERS' WORKSHOP ON Nuclear Science Applications



**FRIDAY, MARCH 7, 2003**

Time	Subject	Topic	
8:00 – 8:30 am	Check-in	Registration and welcome	
8:30 – 9:45 am	Lecture	Radiation sources and radioactivity Nuclear reactions Radiation detection and biological effects	
9:45 – 10:00 am	BREAK		
	Group 1	Group 2	Group 3
10:00 – 11:15 am*	Radiation Detection/ Exponential Law	Neutron Activation Analysis	PULSTAR Reactor
11:15 – 12:30 noon*	Neutron Activation Analysis	PULSTAR Reactor	Radiation Detection/ Exponential Law
12:30 – 1:30 pm	LUNCH		
1:30 – 2:45 pm*	PULSTAR Reactor	Radiation Detection/ Exponential Law	Neutron Activation Analysis
* labs are 45 minutes in length with 15 minutes for additional questions and switch time.			
2:45 – 3:15 pm	Wrap-up and workshop evaluation		

**Teacher Survey 2003 Q1: If a greater need for energy is required in the USA, building more nuclear power plants should fulfil this need.**



◆ Survey:

—■— "Pre-Survey"

—▲— Post-Survey

◆ Answer Key:

1 (Agree Strongly)

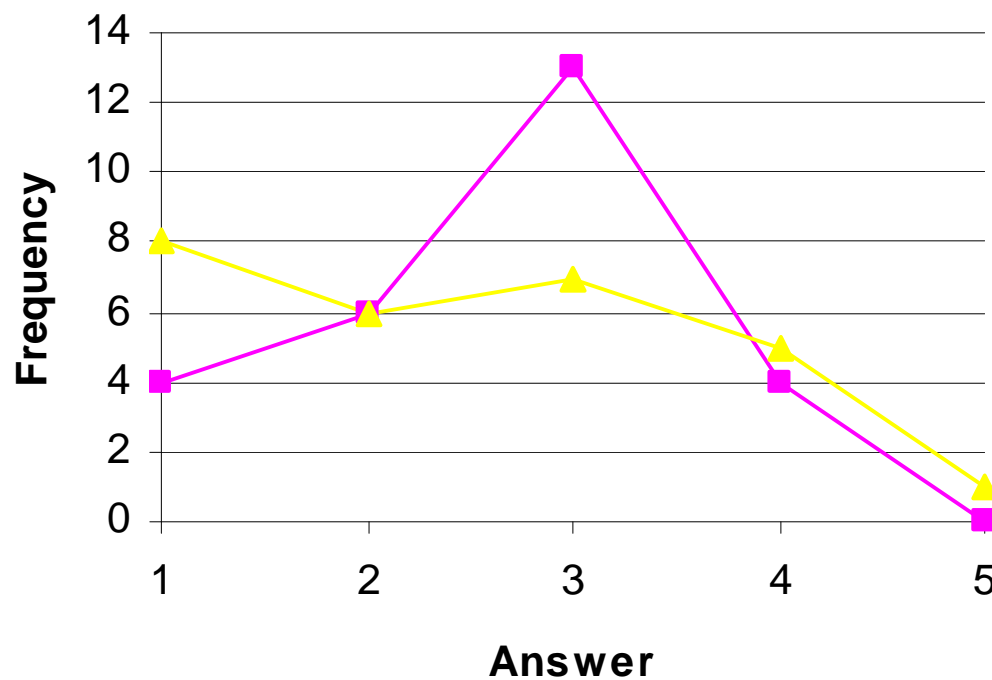
2 (Agree)

3 (Neutral)

4 (Disagree)

5 (Disagree Strongly)

**Teacher Survey 2003 Q2: If a greater need for energy is required in my community area, local utilities should fulfil this need by building more nuclear power plants.**



◆ Survey:

—■— Pre-survey

—▲— Post-Survey

◆ Answer Key:

1 (Agree Strongly)

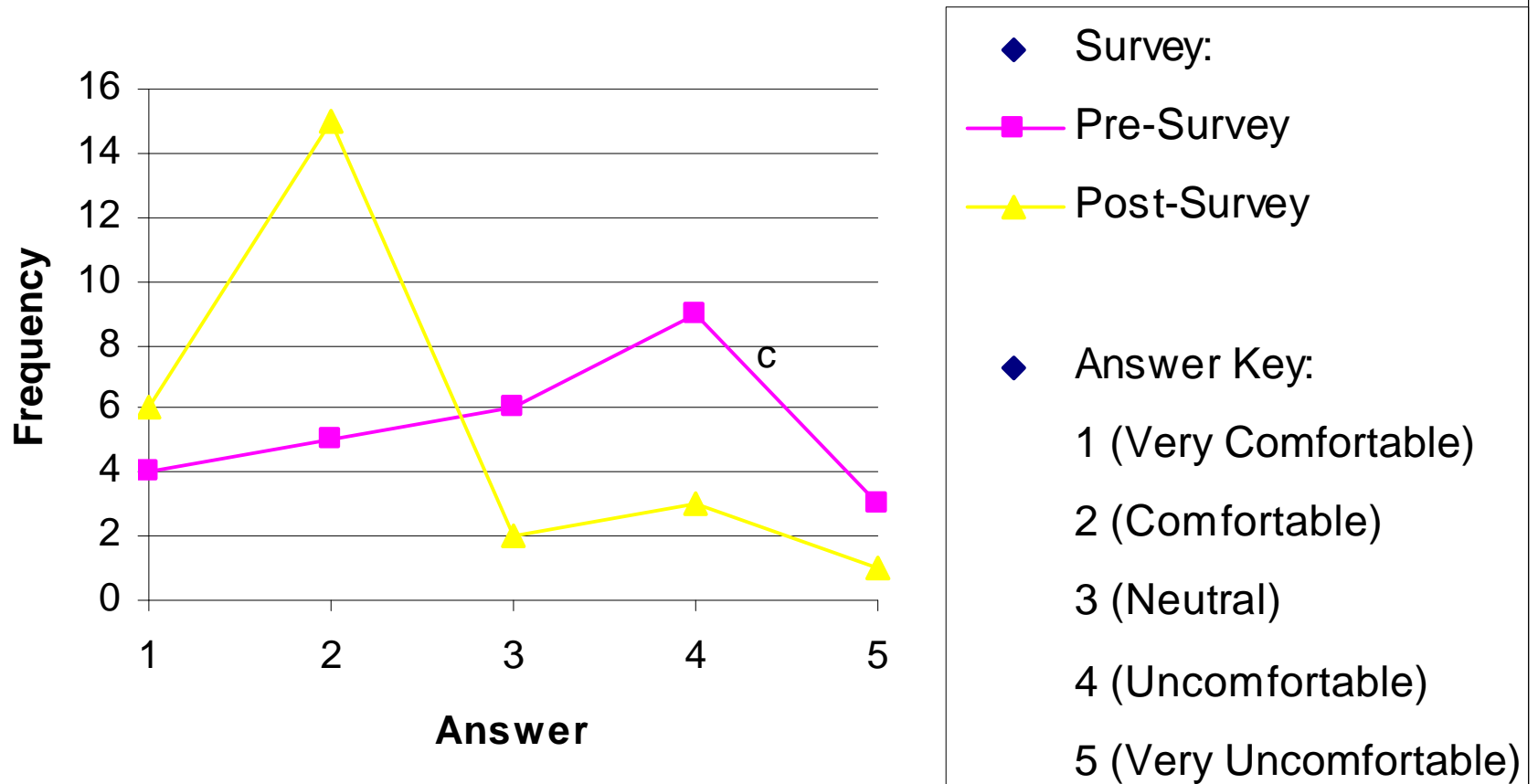
2 (Agree)

3 (Neutral)

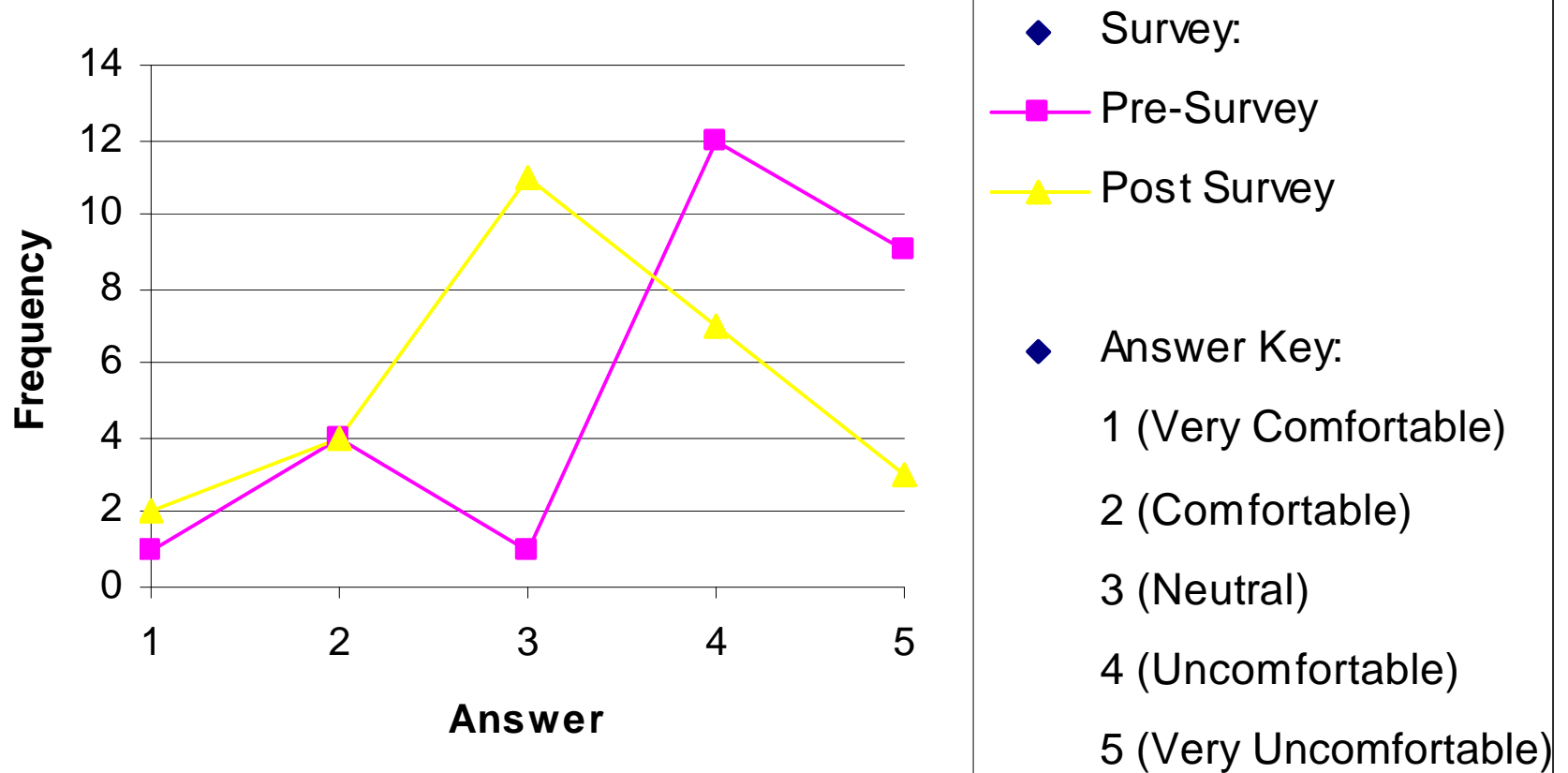
4 (Disagree)

5 (Disagree Strongly)

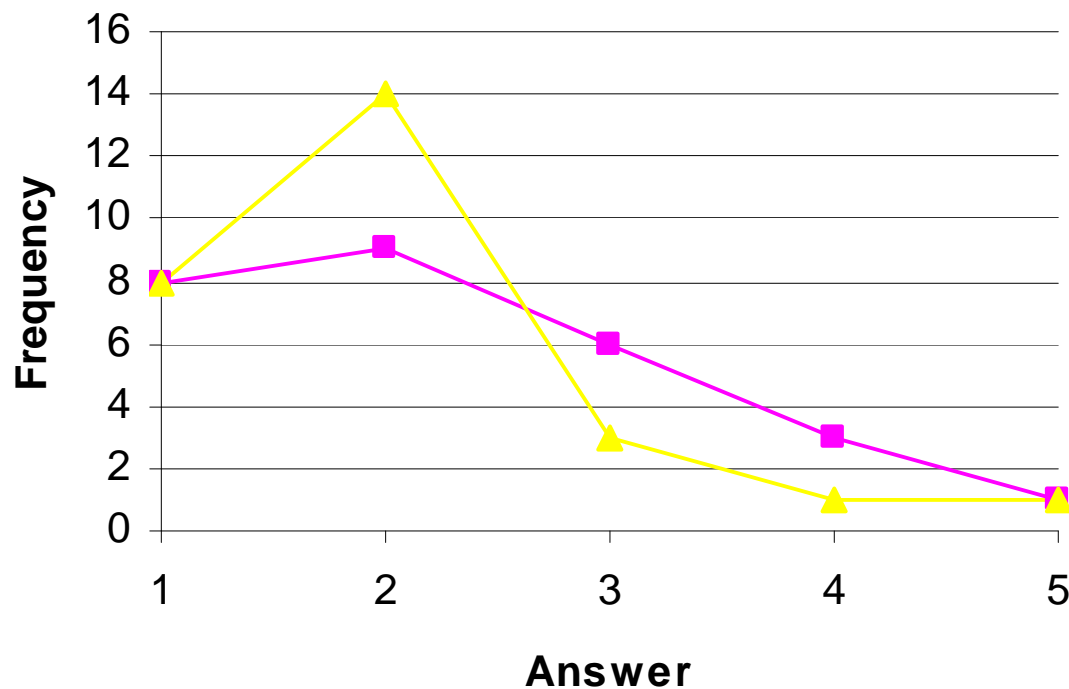
## Teacher Survey 2003 Q4: How comfortable do you feel living within five miles of a nuclear power plant?



**Teacher Survey 2003 Q5: How comfortable do you feel living within five miles of a nuclear waste repository?**



**Teacher Survey 2003 Q6: What level of fear is established in your mind when the words "nuclear" or "radioactive" are used?**



◆ Survey:

—■— Pre-Survey

—▲— Post-Survey

◆ Answer Key:

1 (Very Low Level)

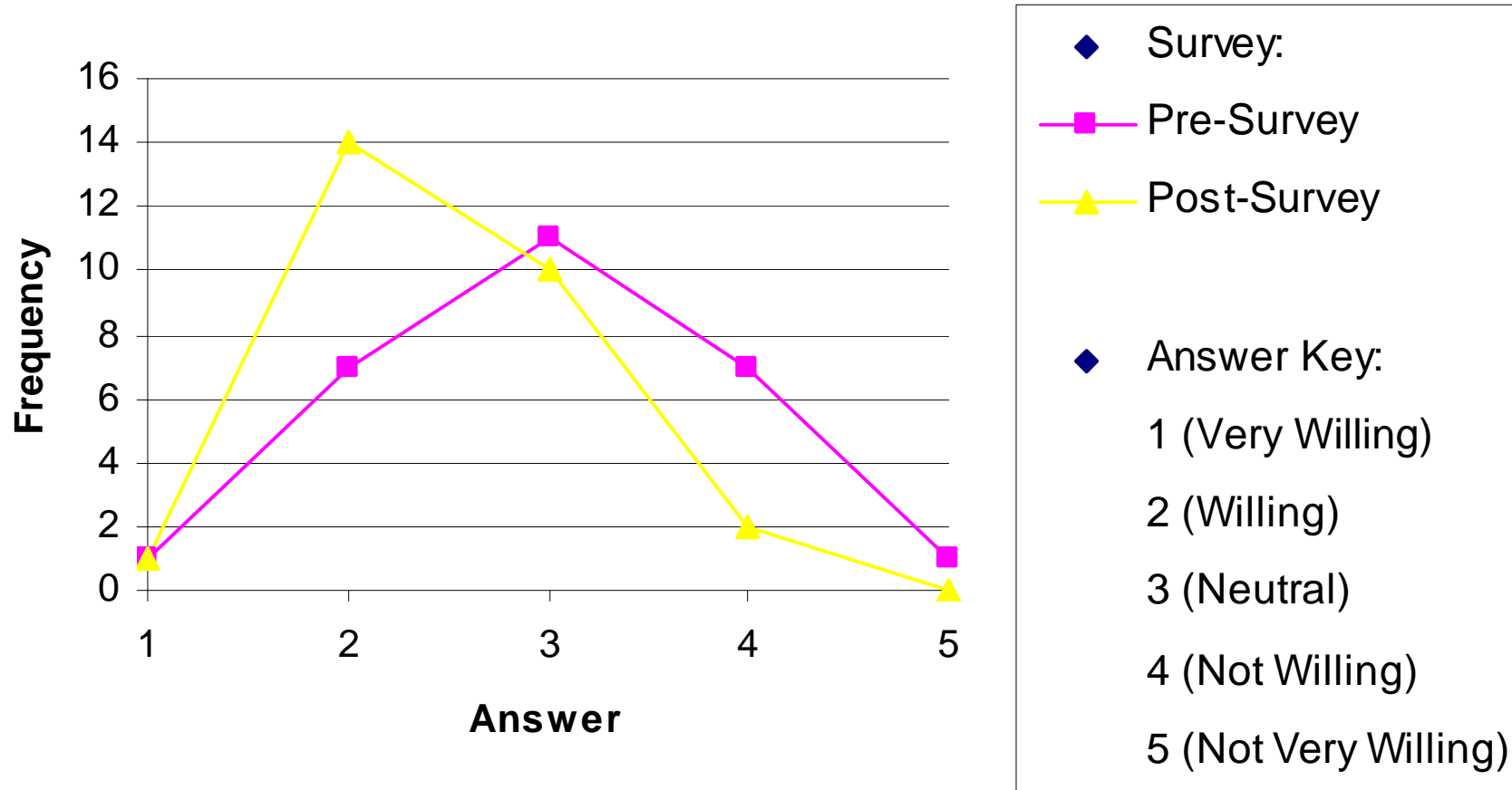
2 (Low Level)

3 (Neutral)

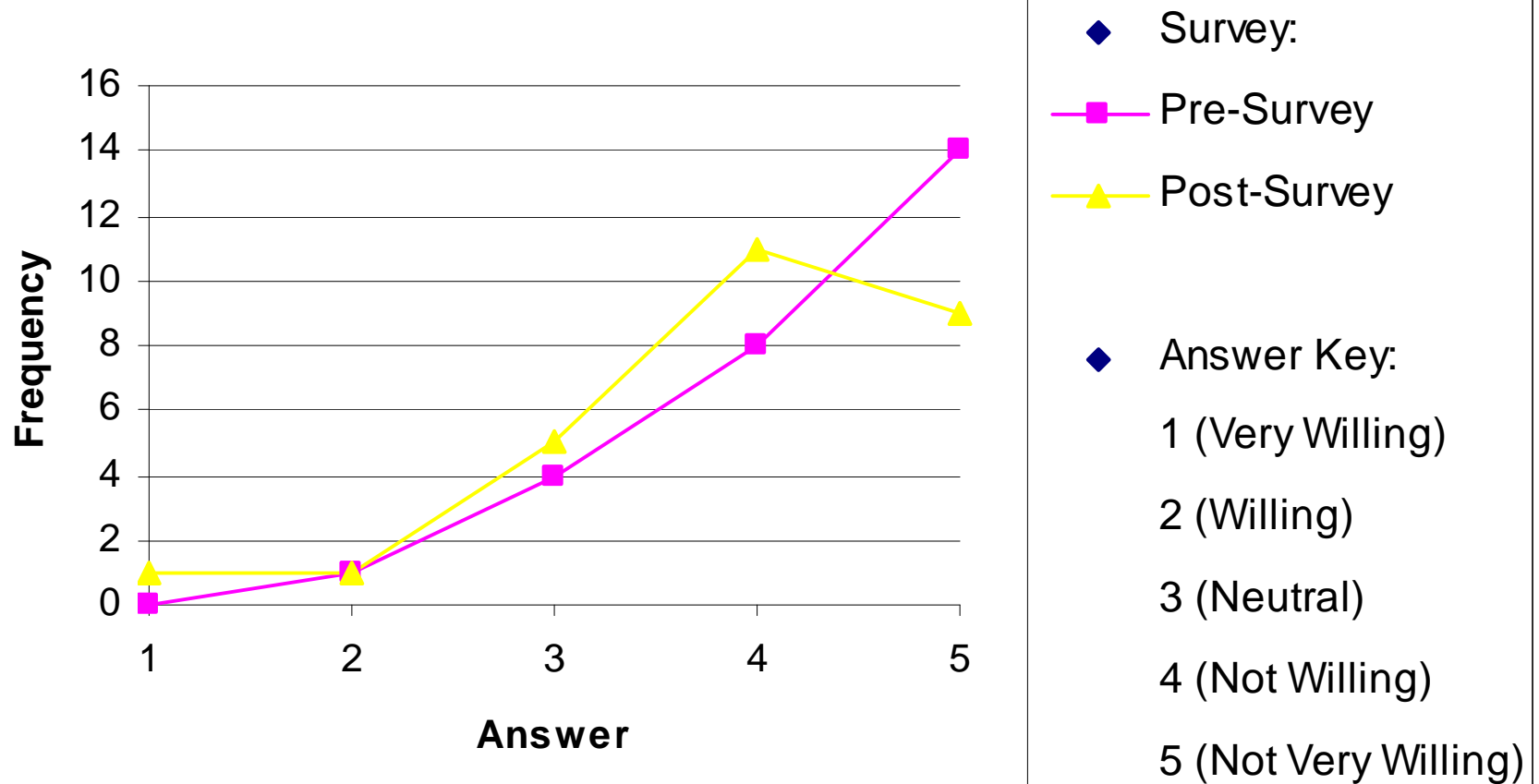
4 (High Level)

5 (Very High Level)

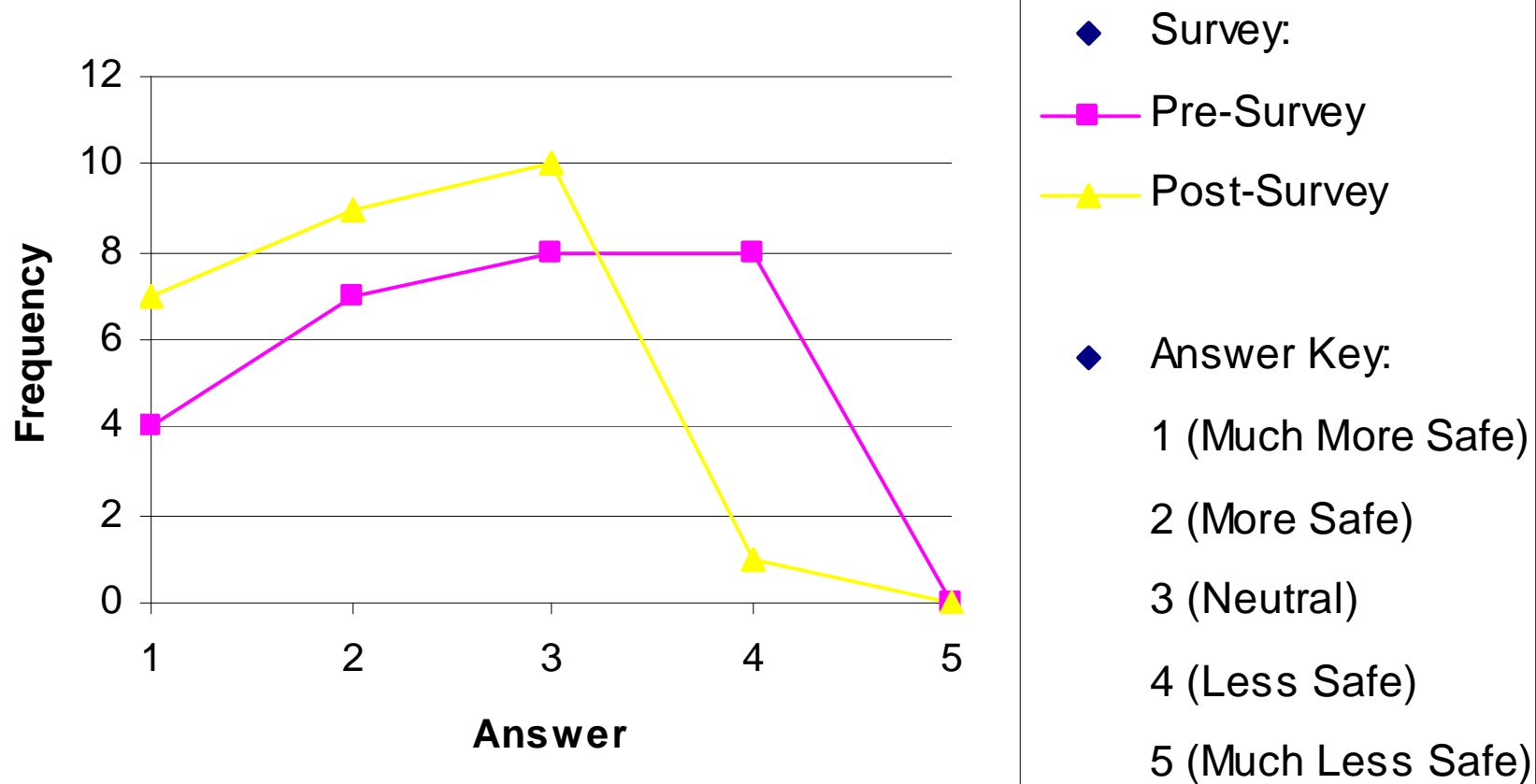
**Teacher Survey 2003 Q8: To what level are you willing to accept risk associated with nuclear/radioactive materials?**



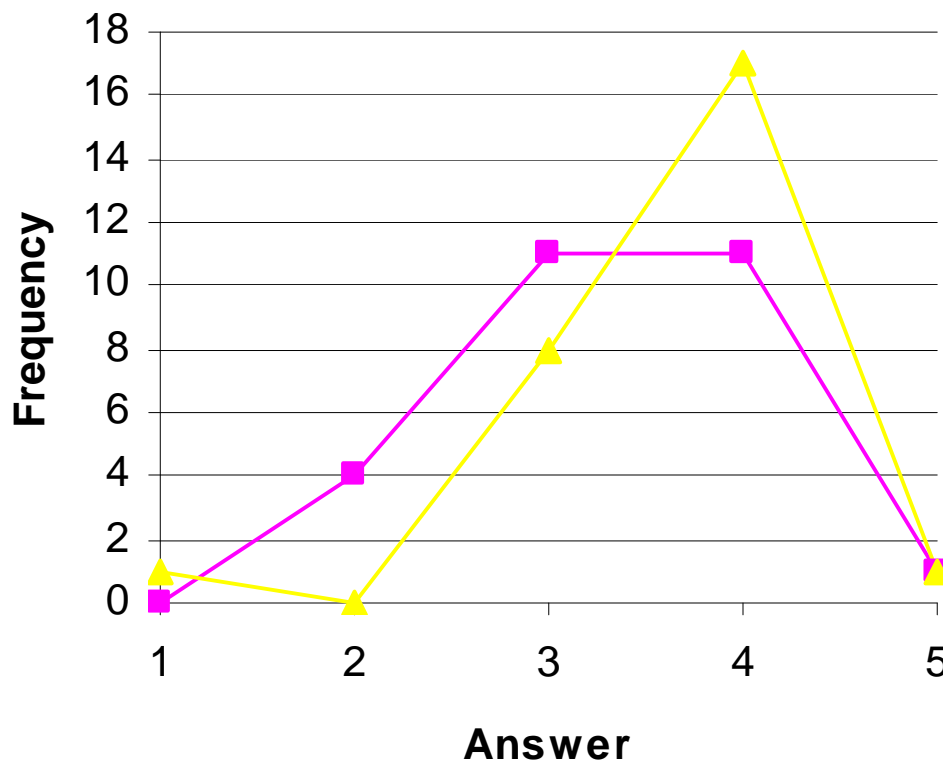
**Teacher Survey 2003 Q9: To what level is the public willing to accept risk associated with nuclear/radioactive materials?**



**Teacher Survey 2003 Q10: Is nuclear energy more environmentally safe than alternate energy sources?**



**Teacher Survey 2003 Q11: How knowledgeable do you consider yourself about topics concerning nuclear issues?**



◆ Survey:

—■— Pre-Survey

—▲— Post-Survey

◆ Answer Key:

1 (No knowledge at all)

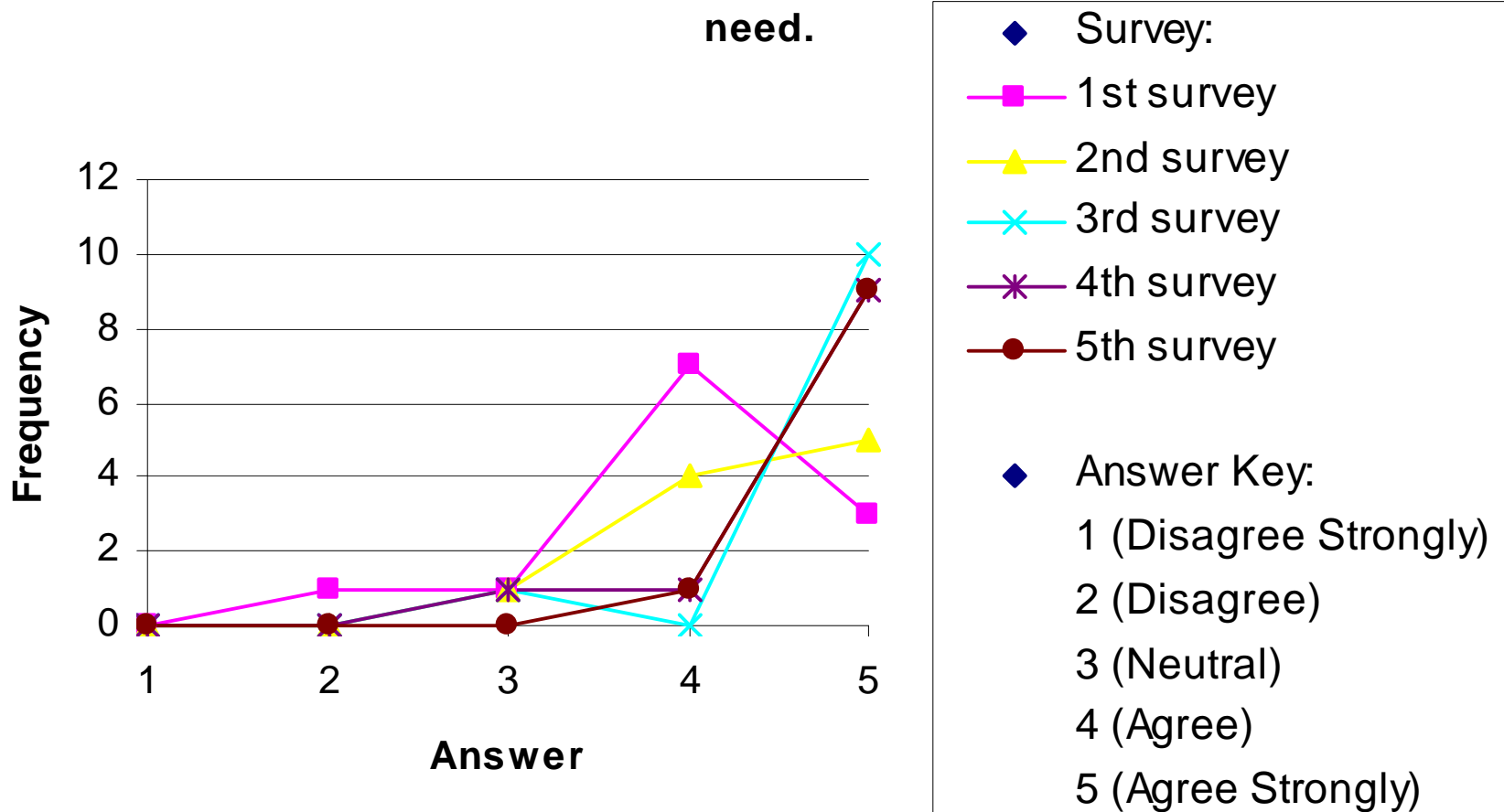
2 (Some Knowledge)

3 (Neutral)

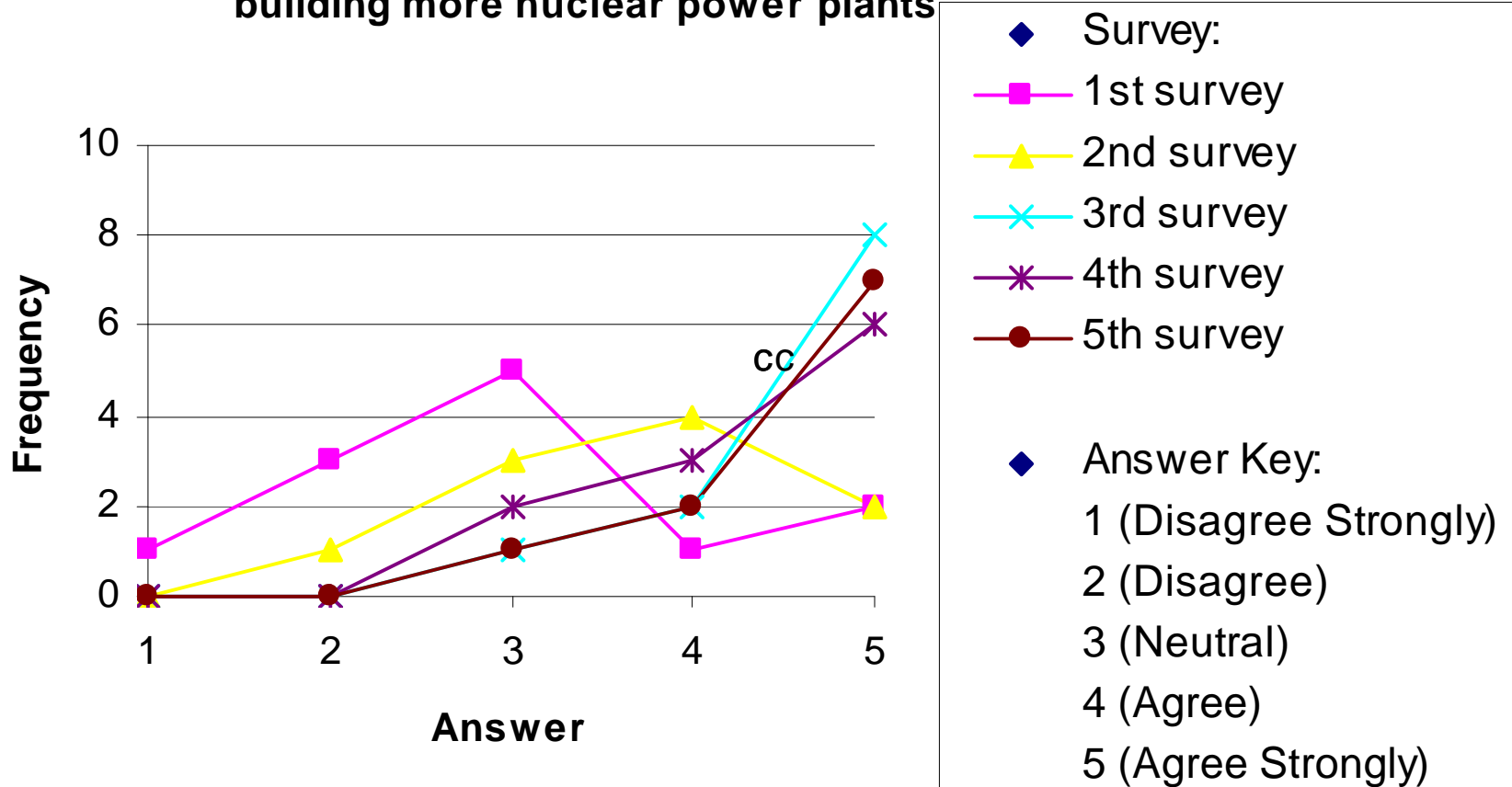
4 (Knowledgeable)

5 (Very Knowledgeable)

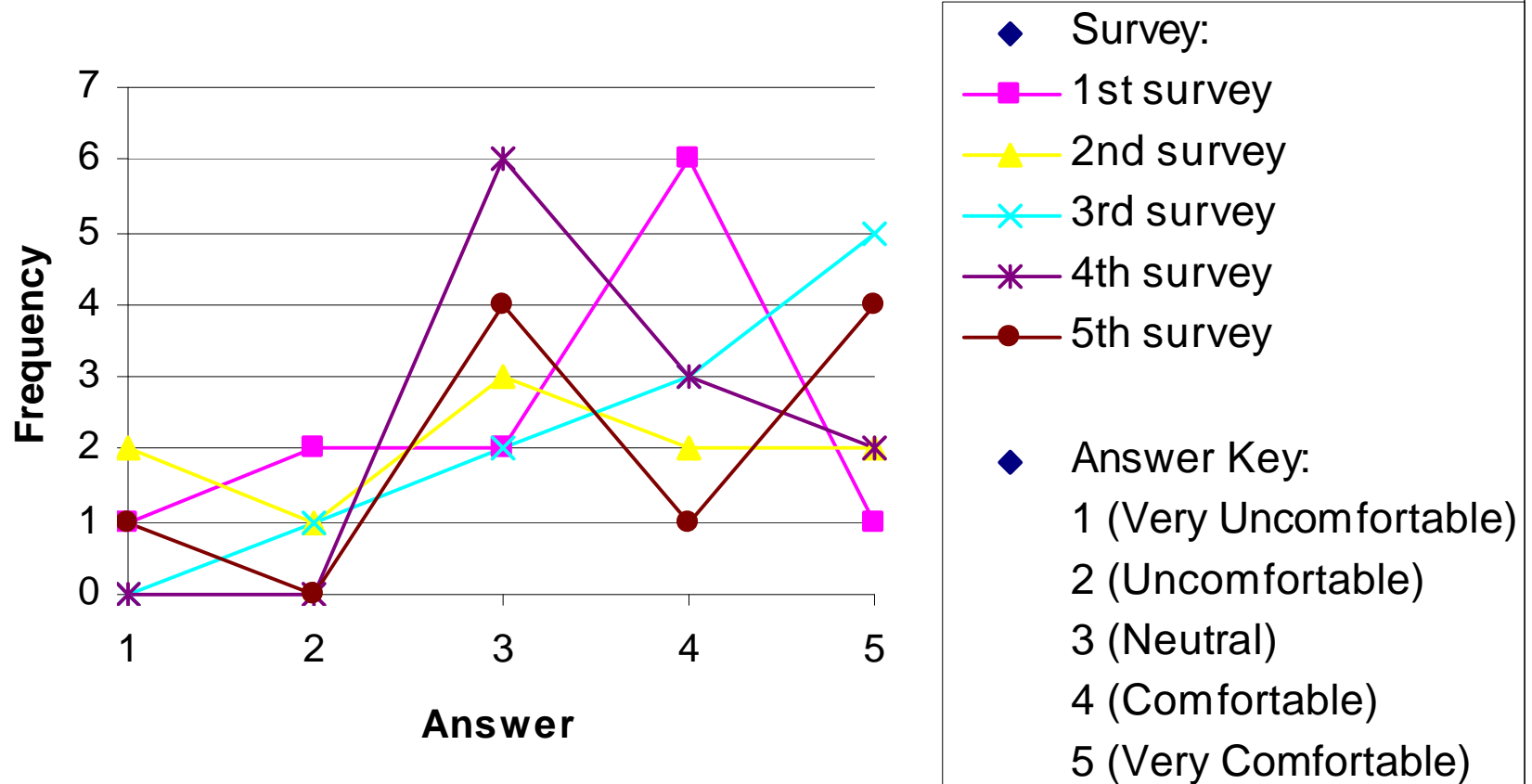
**HS Summer 2002 Q1: If a greater need for energy is required in the USA, building more nuclear power plants should fulfil this need.**



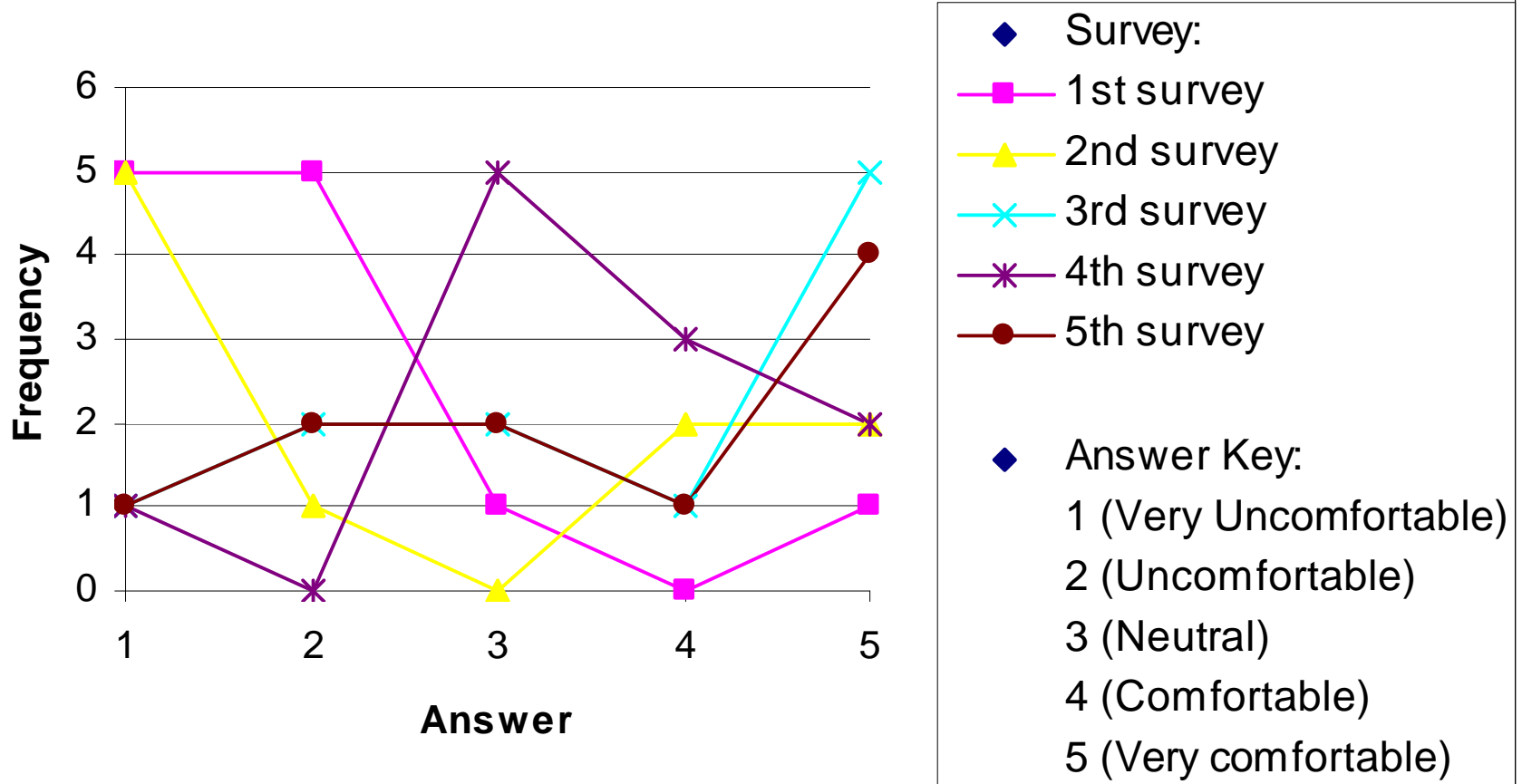
**HS Summer 2002 Q2: If a greater need for energy is required in my community area, local utilities should fulfil this need by building more nuclear power plants**



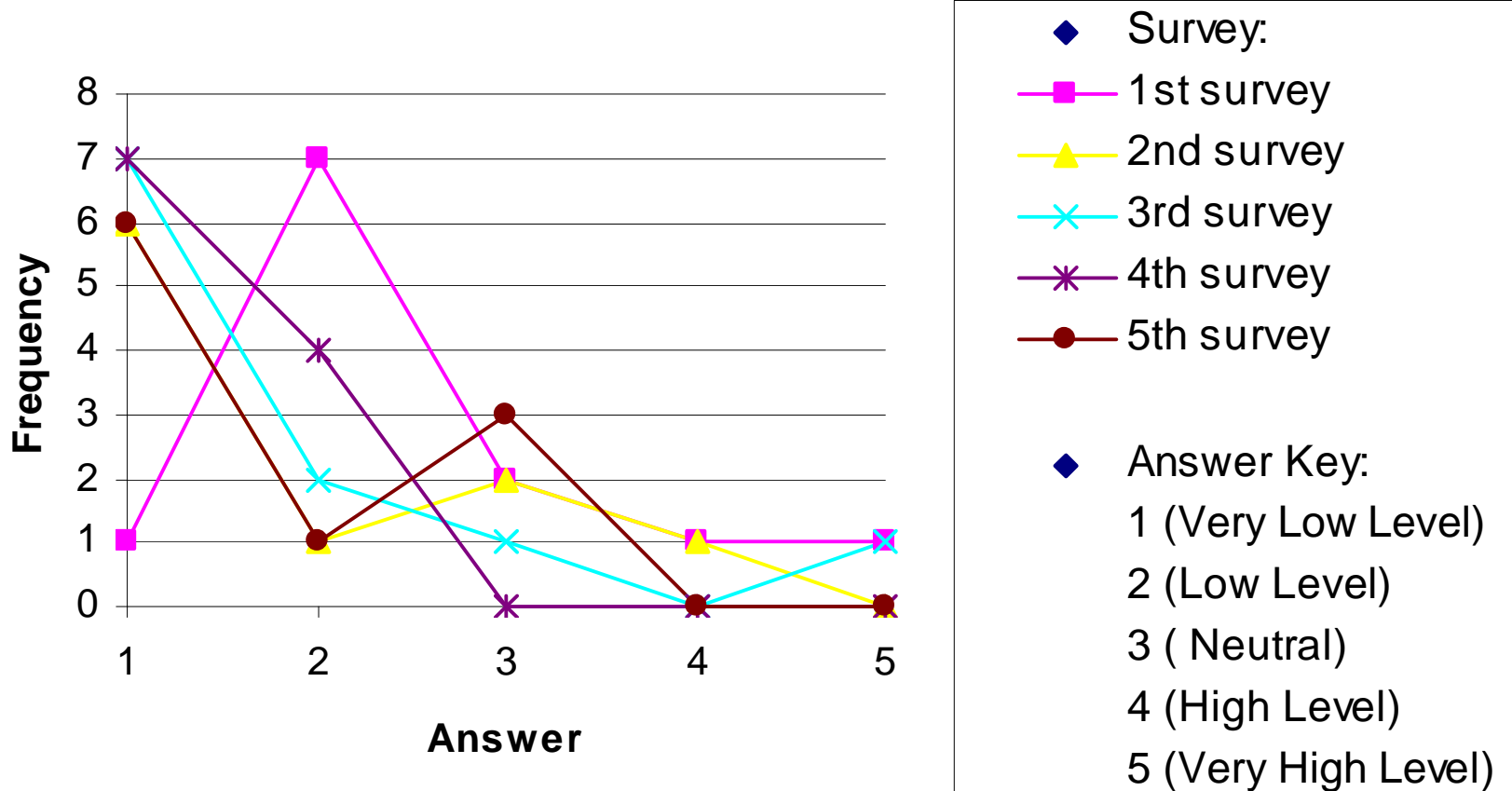
## HS Summer 2002 Q4: How comfortable do you feel living within five miles of a nuclear power plant?



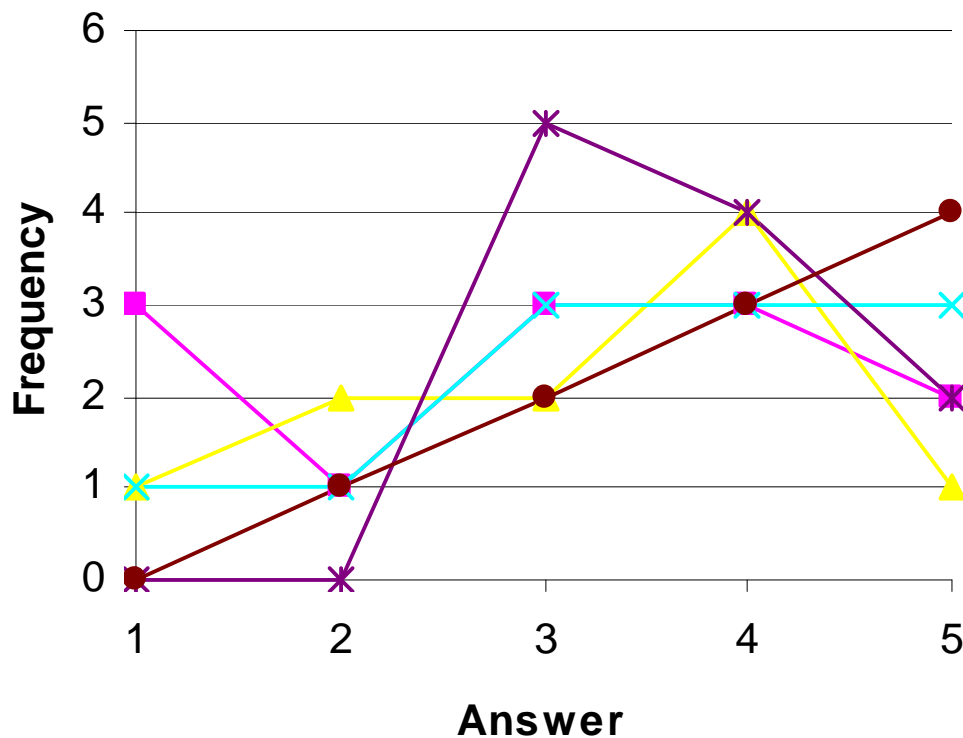
## HS Summer 2002 Q5: How comfortable do you feel living within five miles of a nuclear waste repository?



**HS Summer 2002 Q6: What level of fear is established in your mind when the words "nuclear" or "radioactive" are used?**



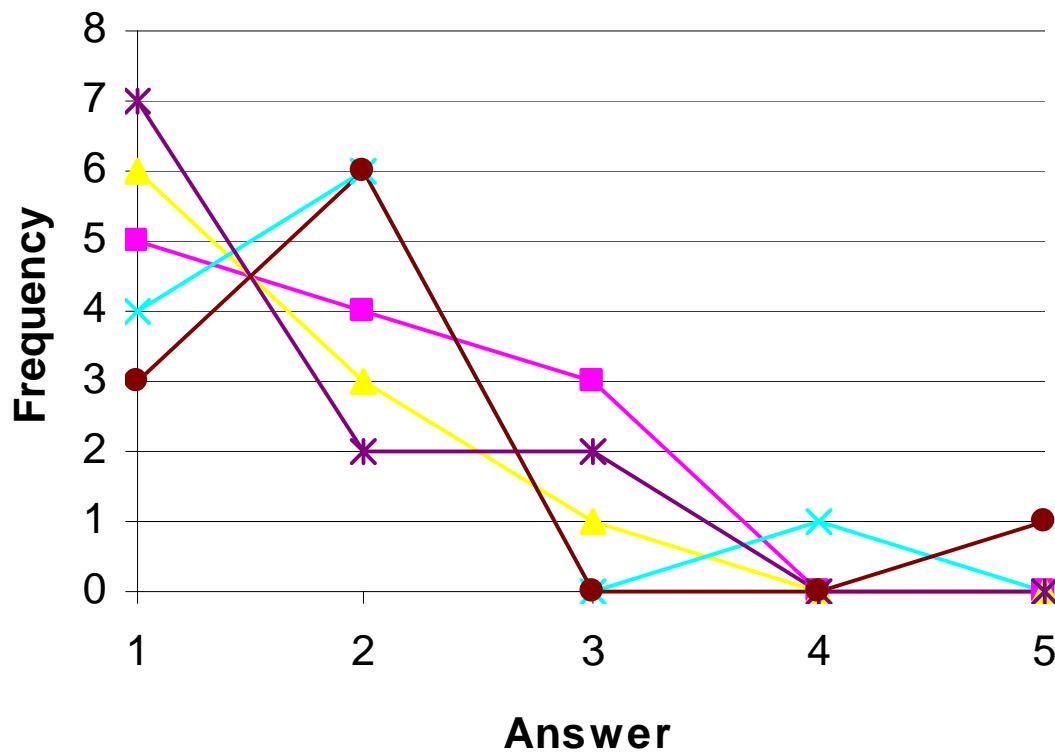
## HS Summer 2002 Q8: To what level are you willing to accept risk associated with nuclear/radioactive materials?



- ◆ Survey:
- 1st survey
  - ▲— 2nd survey
  - ×— 3rd survey
  - \*— 4th survey
  - 5th survey

- ◆ Answer Key:
- 1 (Not Very Willing)
  - 2 (Not Willing)
  - 3 (Neutral)
  - 4 (Willing)
  - 5 (Very Willing)

## HS Summer 2002 Q9: To what level is the public willing to accept risk associated with nuclear/radioactive materials?



◆ Survey:

—■— 1st survey

—▲— 2nd survey

—×— 3rd survey

—\*— 4th survey

—●— 5th survey

◆ Answer Key:

1 (Not Very Willing)

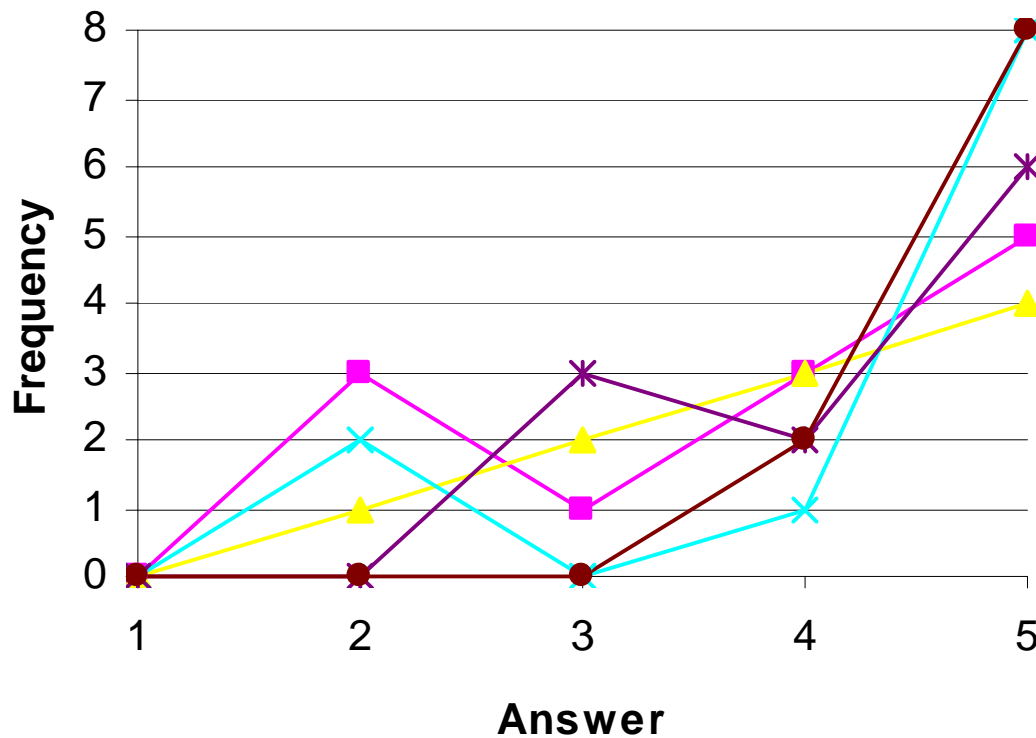
2 (Not Willing)

3 (Neutral)

4 (Willing)

5 (Very Willing)

## HS Summer 2002 Q10: Is nuclear energy more environmentally safe than alternate energy sources?



◆ Survey:

—■— 1st survey

—▲— 2nd survey

—×— 3rd survey

—\*— 4th survey

—●— 5th survey

◆ Answer Key:

1 (Much Less Safe)

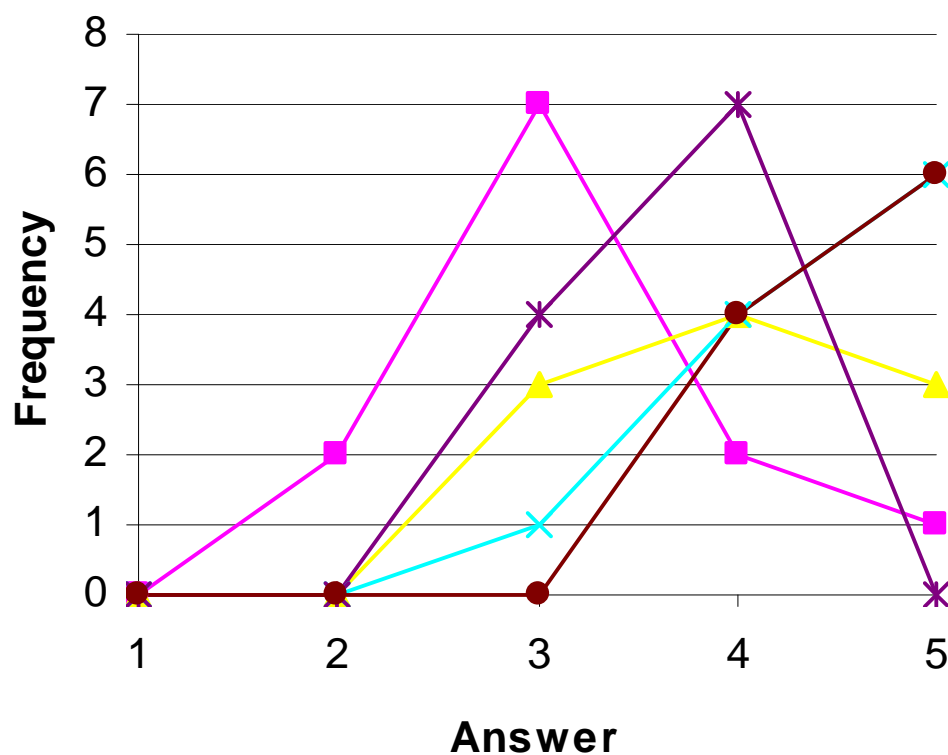
2 (Less Safe)

3 (Neutral)

4 (More Safe)

5 (Much More Safe)

## HS Summer 2002 Q11: How knowledgeable do you consider yourself about topics concerning nuclear issues?



◆ Survey:

—■— 1st survey

—▲— 2nd survey

—×— 3rd survey

—\*— 4th survey

—●— 5th survey

◆ Answer Key:

1 (No knowledge at all)

2 (Some Knowledge)

3 (Neutral)

4 (Knowledgeable)

5 (Very Knowledgeable)



# Summary Observations

- Properly conducted educational activities can impact the perception of the public concerning radiation.
- This may be due to the fact that the perception of most of the public is formed by peripheral information processing.
- Education may not affect the risk perception once it is formed through central information processing.



# Lessons

- For any educational effort to be effective, the information exchange must affect the value system of the participating individuals.
- This requires a properly conducted information exchange that involves issue-relevant examinations/deliberations under the atmosphere of trust
- An atmosphere of trust can be generated based on:
  - ◆ A belief that those with whom you interact will take your interest into account;
  - ◆ A sense of confidence that the party trusted is able to empathize with your interests and is competent to act on that knowledge.



# If trust and credibility is weak

- Defying a negative stereotype is key.
- Nothing less than a new culture of awareness is called for.
- Every organizational action must be understood as having a potential impact on an agency's trustworthiness.
- Organizations may be forced to make new and heavy investments in time and other resources.
- Past mistakes must be admitted and exaggerated claims and promises that cannot be fulfilled should be avoided.



# Developmental stages in risk communication

- All we have to do is get the numbers right
- All we have to do is to tell them the numbers
- All we have to do is show them that they've accepted similar risks in the past
- All we have to do is show them it's a good deal for them
- All we have to do is treat them nice
- All we have to do is make them partners
- All of the above